Simultaneous removal of toxic ammonia and lettuce cultivation in aquaponic system using microwave pyrolysis biochar

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ABSTRACT

This study examined an aquaponic approach of circulating water containing ammonia excretions from African catfish grown in an aquaculture tank for bacterial conversion into nitrates, which then acted as a nutrient substance to cultivate lettuce in hydroponic tank. We found that microwave pyrolysis biochar (450 g) having microporous (1.803 nm) and high BET surface area (419 m^2/g) was suitable for use as biological carrier to grow nitrifying bacteria (63 g of biofilm mass) that treated the water quality through removing the ammonia (67%) and total suspended solids (68%), resulting in low concentration of remaining ammonia (0.42 mg/L) and total suspended solid (59.40 mg/L). It also increased the pH (6.8), converted the ammonia into nitrate (29.7 mg/L), and increased the nitrogen uptake by the lettuce (110 mg of nitrogen per plant), resulting in higher growth in lettuce (0.0562 %/day) while maintaining BOD_5 level (3.94 mg/L) at acceptable level and 100% of catfish survival rate. Our results demonstrated that microwave pyrolysis biochar can be a promising solution for growing nitrifying bacteria in aquaponic system for simultaneous toxic ammonia remediation and generation of nitrate for growing vegetable in aquaculture industry.

KEYWORDS

Aquaponics; Pyrolysis; Biochar; Ammonia; Lettuce

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